

Improved Rocket Test Engine Video Recording with Computational Photography and Computer Vision Techniques

Completed Technology Project (2014 - 2015)



Project Introduction

Rocket engine flight certification ground testing requires high-speed video recording that can capture essential information for NASA. This need is particularly true in the event of a mishap, when investigations into the underlying cause ensue. The current operational imaging system at SSC has poor resolution and records to VHS tapes that are no longer commercially available. The test bed project developed a high-speed High Dynamic Range (HDR) imaging capability using two boresighted cameras to demonstrate what is achievable with a single camera. This project will also lay the foundation for other Rocket Propulsion Test high-speed recording initiatives as well as rocket engine and launch initiatives.

High-speed video recording of rocket engine tests has several challenges. A single image contains both extremely bright and extremely dark regions. The bright regions are due to plume emissions and bright reflections and the dark regions are weakly illuminated solid structures. High-speed video cameras do not have sufficient dynamic range to properly expose both bright and dark areas without partially saturating due to the limited bits (typically 8-10) available. Saturating on the bright side will wash out all bright areas making it impossible to distinguish bright detail and likewise saturating on the dark side will blacken out all dark areas making it impossible to see into the shadows and distinguish any dark detail. Rocket motor testing also contains high-speed transient events that require high frame rate cameras and the scenes contain complex three-dimensional test articles and plume formations that are difficult to capture with a simple two-dimensional image. In addition, this difficult test environment is harsh and subject to large acoustic emissions, vibration and heat. If a test anomaly occurs there is an added risk of debris or explosion. During this project, two high speed HD color video cameras were boresighted using a beam splitter to produce a HDR video. Successful high speed HDR video was acquired on a scene containing bright objects approximately 10,000 times brighter than closely situated dim objects. The type of data is useful for simulating potential single camera based implementations.

Anticipated Benefits

The technologies developed are extensible to other NASA high dynamic range imaging needs including launch monitoring and space-based rover and robotics missions.



Technology Development
Program Logo

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Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Stennis Space Center (SSC)

Responsible Program:

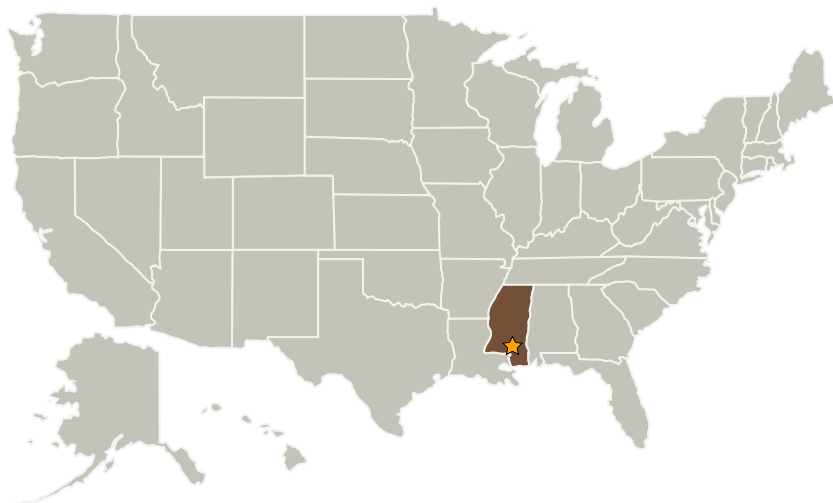
Center Independent Research & Development: SSC IRAD

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Stennis Space Center(SSC)	Lead Organization	NASA Center	Stennis Space Center, Mississippi

Co-Funding Partners	Type	Location
Innovative Imaging and Research Corporation	Industry Women-Owned Small Business (WOSB)	Stennis Space Center, Mississippi

Primary U.S. Work Locations

Mississippi

Project Management

Program Manager:

Ramona E Travis

Project Manager:

Curtis D Armstrong

Principal Investigator:

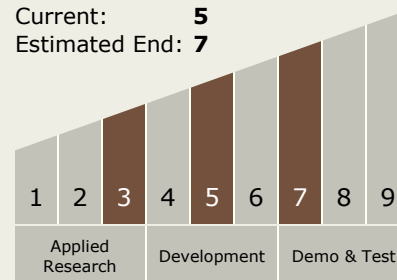
Howard J Conyers

Co-Investigator:

Mary A Pagnutti

Technology Maturity (TRL)

Start: 3
Current: 5
Estimated End: 7



Technology Areas

Primary:

- TX13 Ground, Test, and Surface Systems
 - └ TX13.2 Test and Qualification
 - └ TX13.2.4 Verification and Validation of Ground, Test, and Surface Systems

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Images



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Technology Development Program

Logo

(<https://techport.nasa.gov/image/19224>)